



THE UNIVERSITY OF
CHICAGO

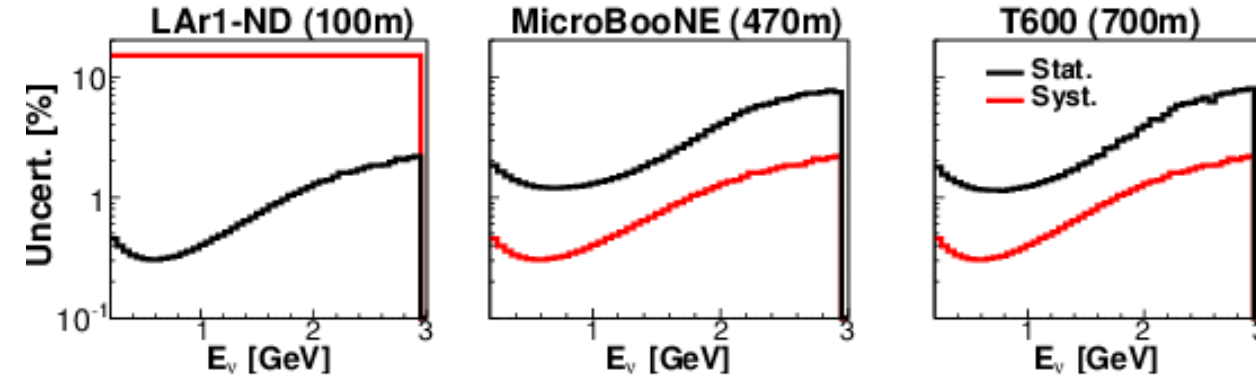
Planning Meeting Debrief: Sensitivity Studies

Corey Adams, Joseph Zennamo

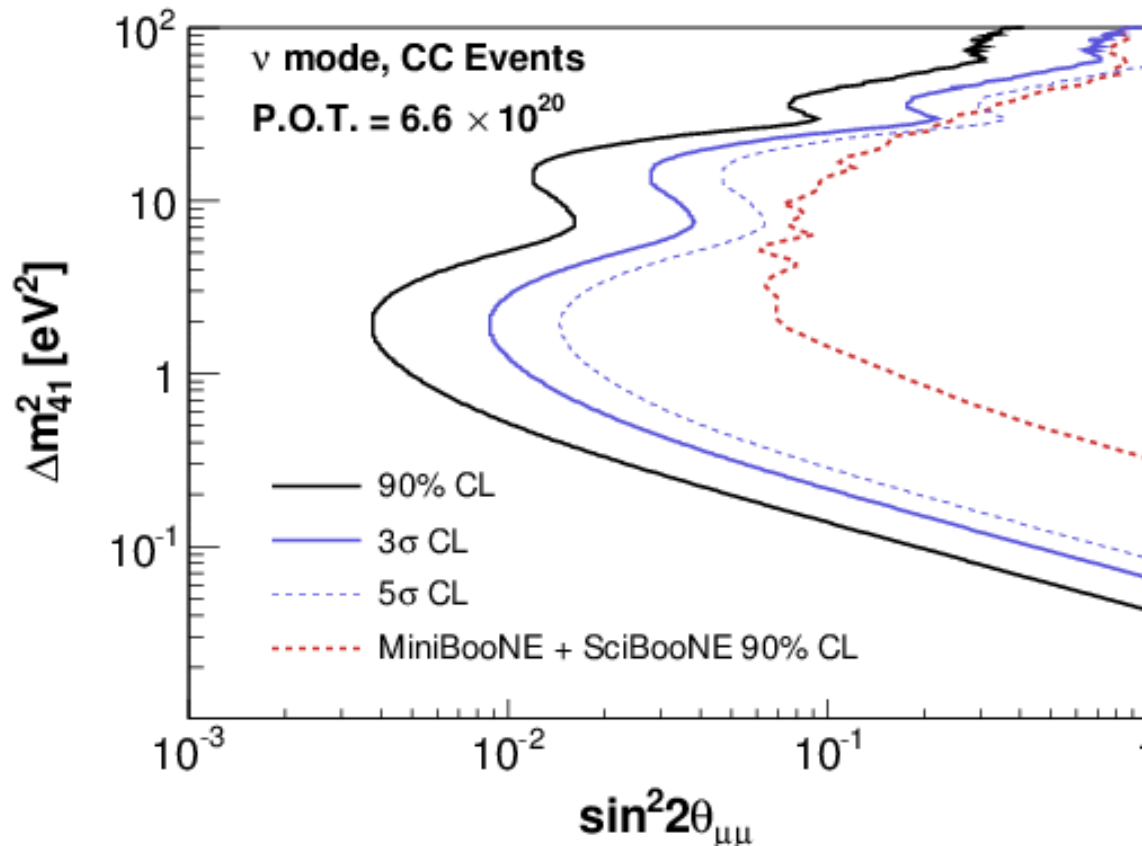
May 6th, 2014

LAr1-ND Biweekly Meeting

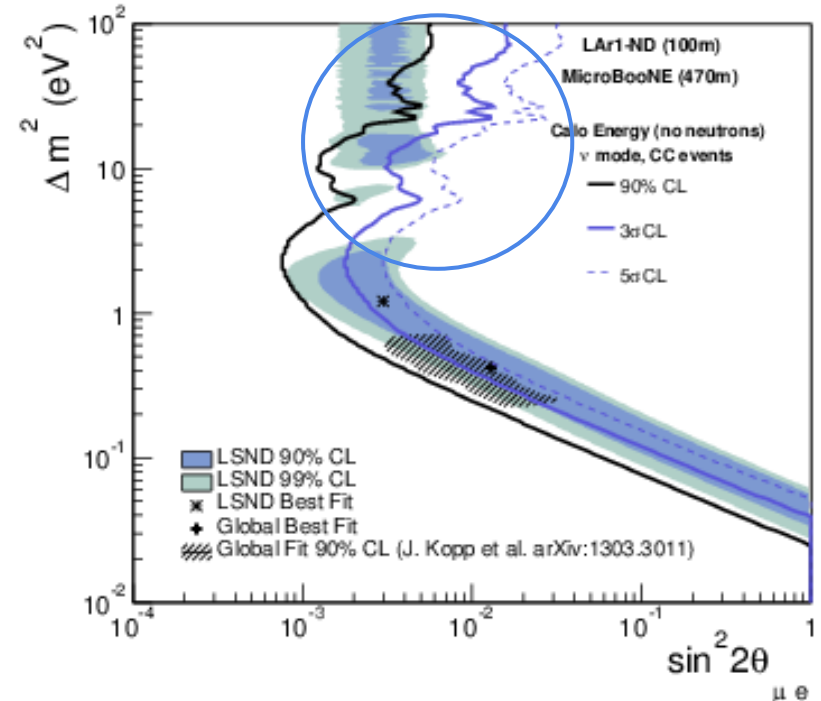
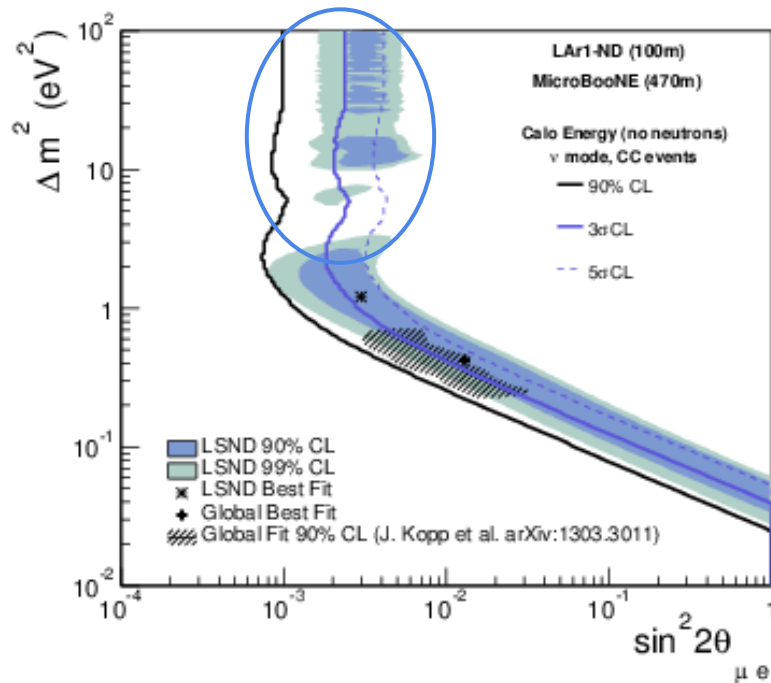
ν_μ Disappearance (T600 @ 700m)



Limiting case sensitivity is if statistics of ND events constrain the predictions in μ BooNE and T600 without additional systematics

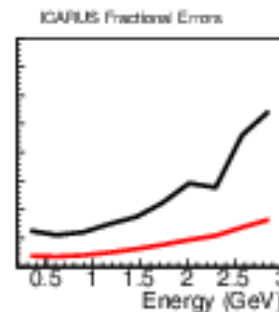
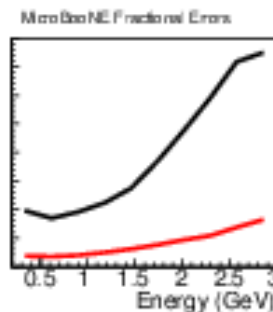
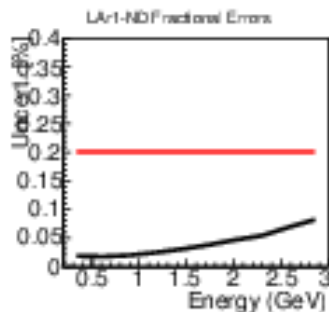
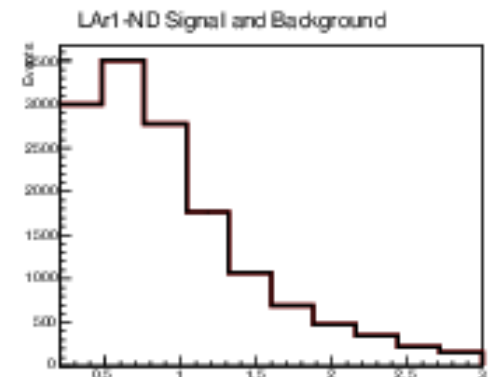
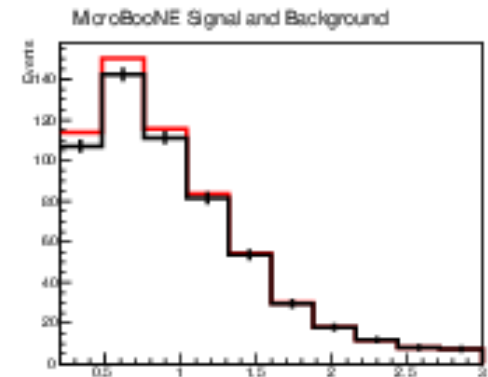
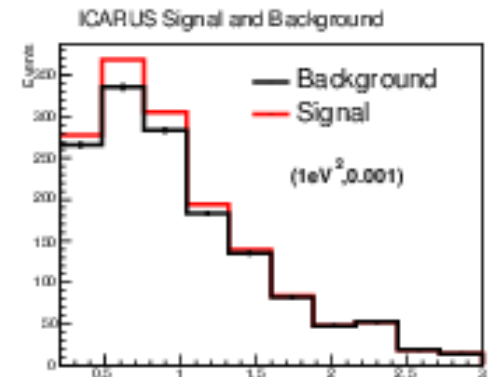
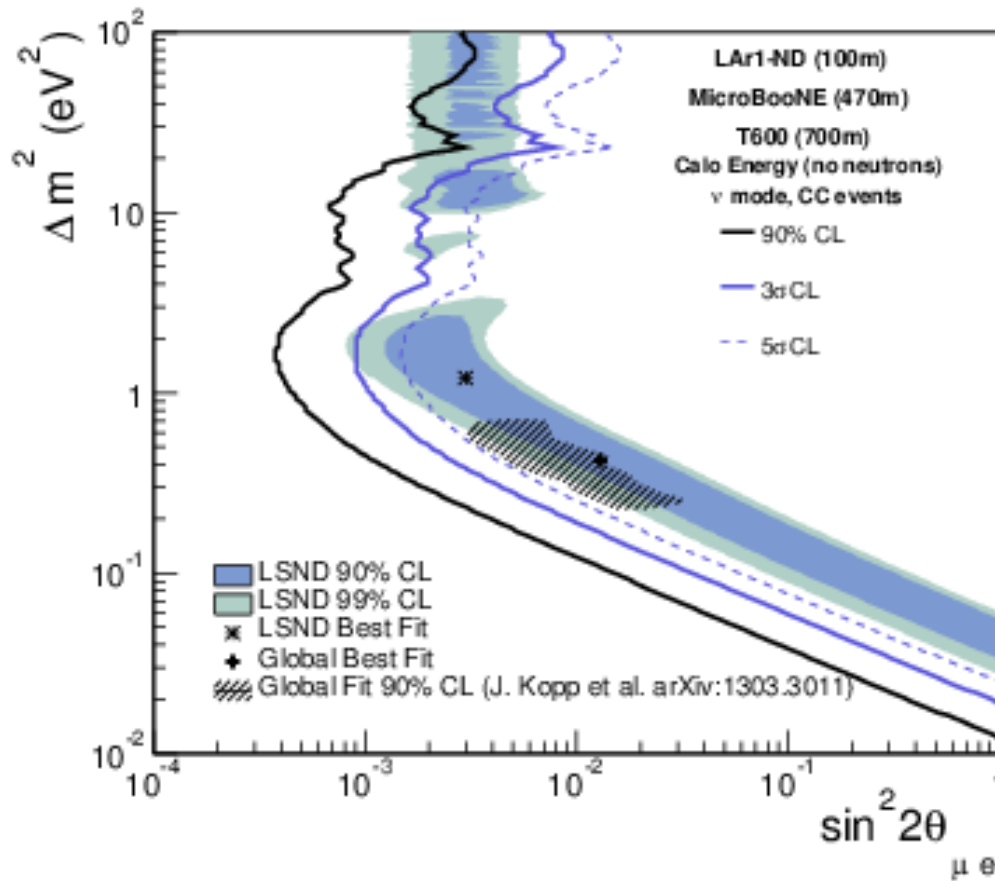


Electron Neutrino Appearance Sensitivity Convergence



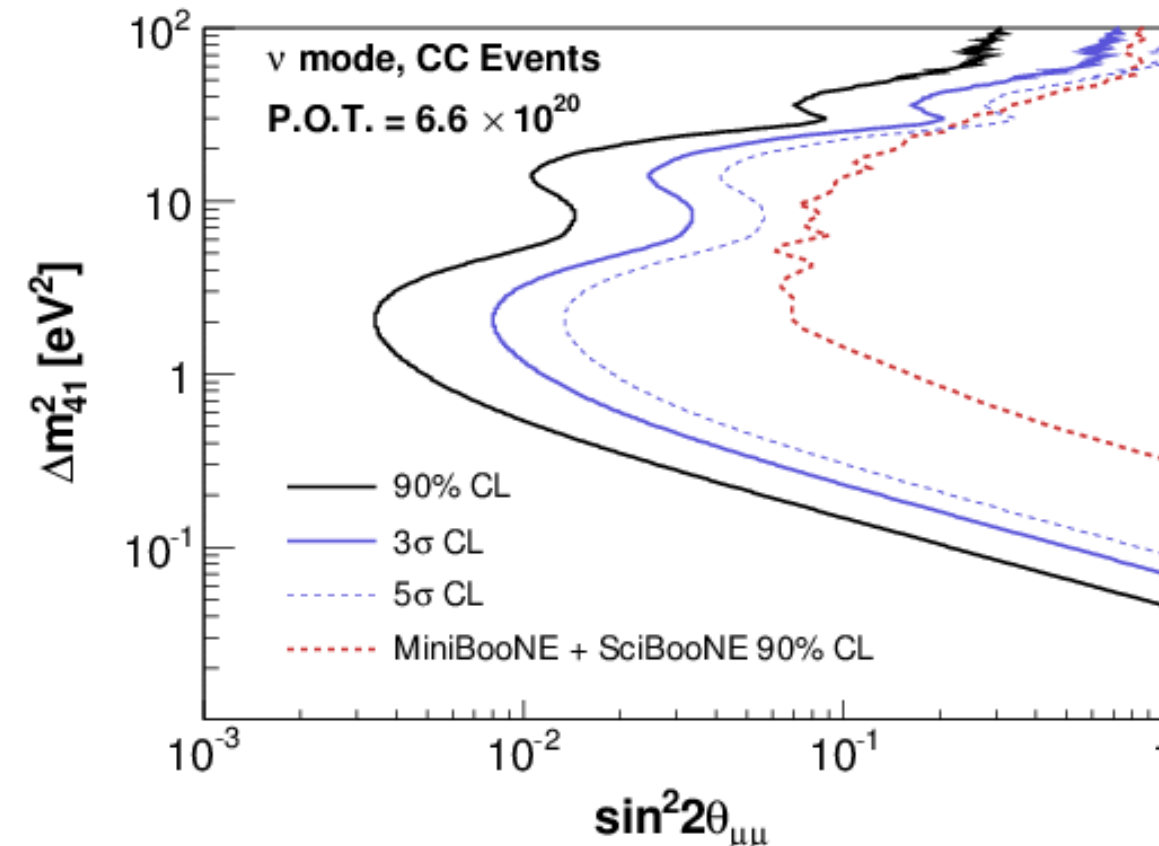
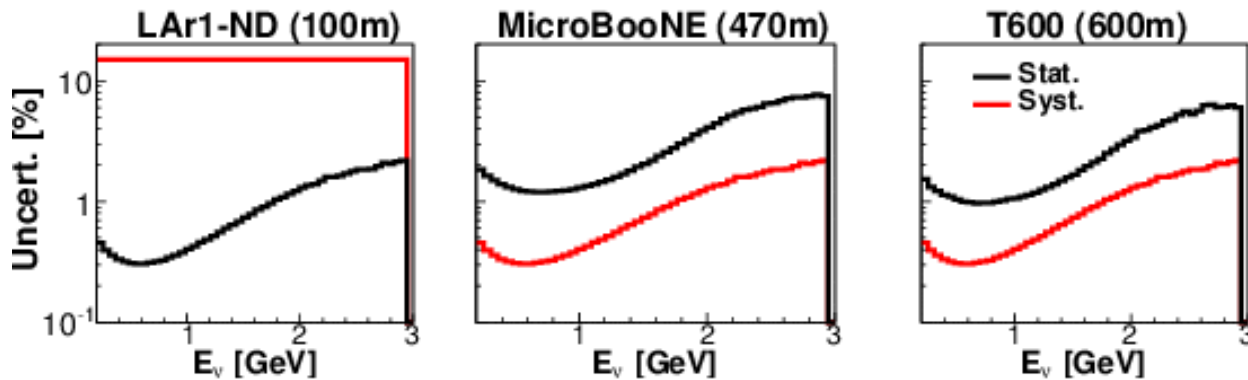
Thanks to some great discussions yesterday we have reached a consensus on the sensitivity calculation! Have implemented same approach to shape-only oscillation analyses.

ν_e Appearance (T600 @ 700m)



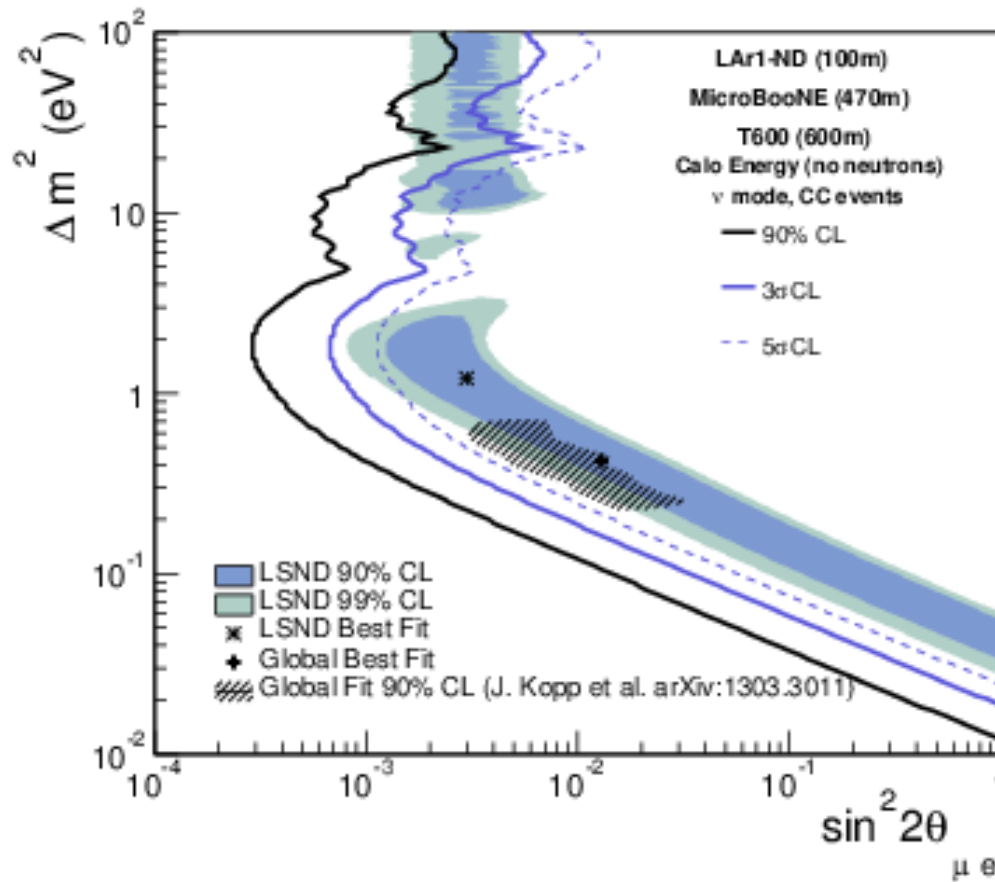
stat
syst

ν_μ Disappearance (T600 @ 600m)



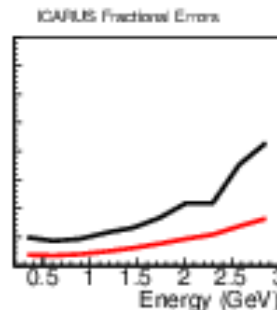
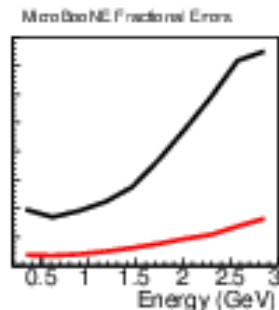
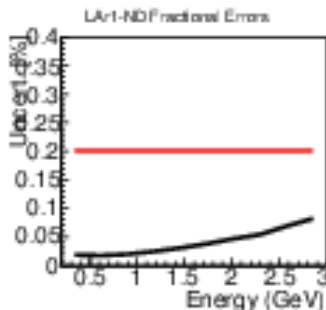
Slight increase in statistics in the T600 as one would expect

ν_e Appearance (T600 @ 600m)



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stat
syst

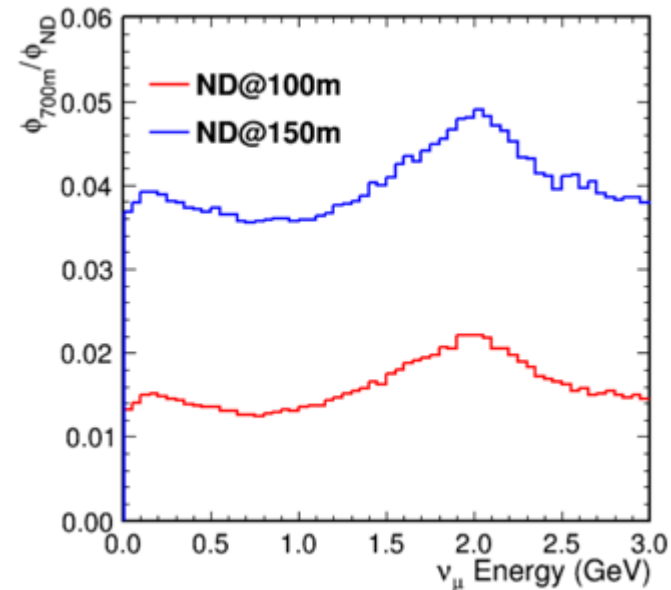
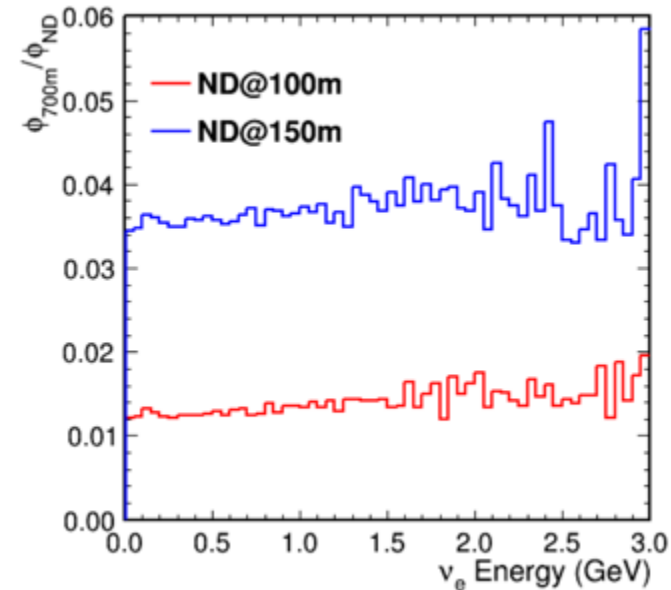


Flux Ratio Uncertainty

The next thing for us to add will be an uncertainty on the ratio of the fluxes for the near and far detector

The machinery exists to propagate uncertainties using the MiniBooNE beam Monte Carlo

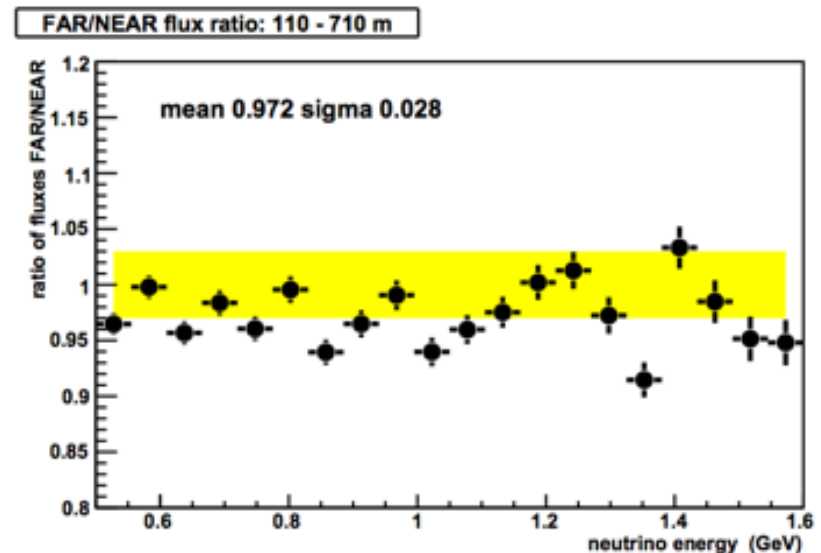
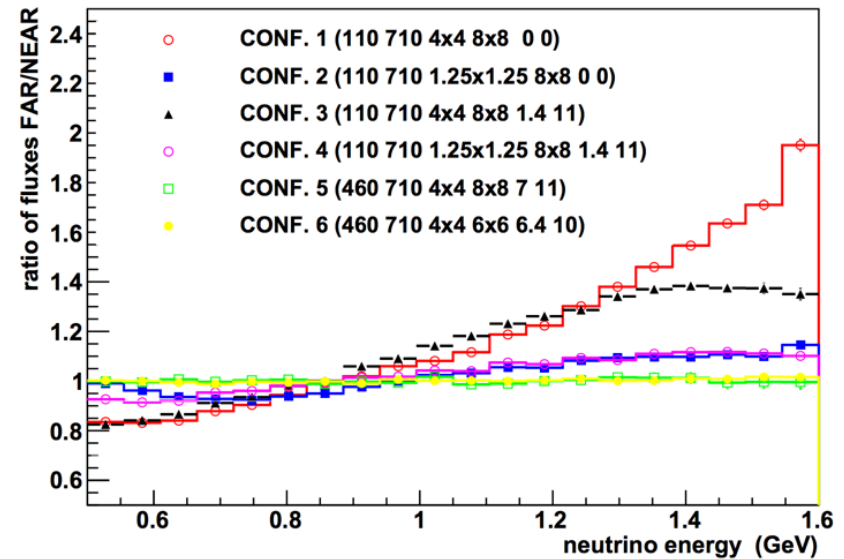
In the coming weeks this will be implemented



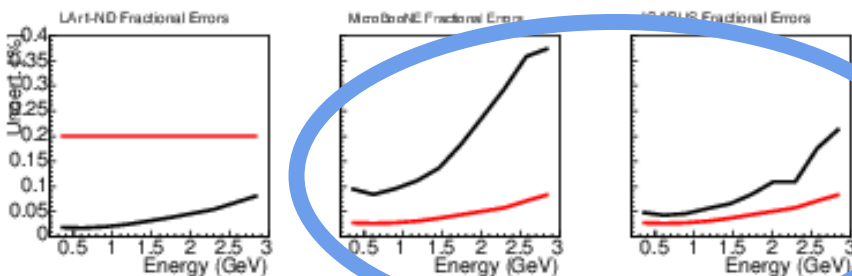
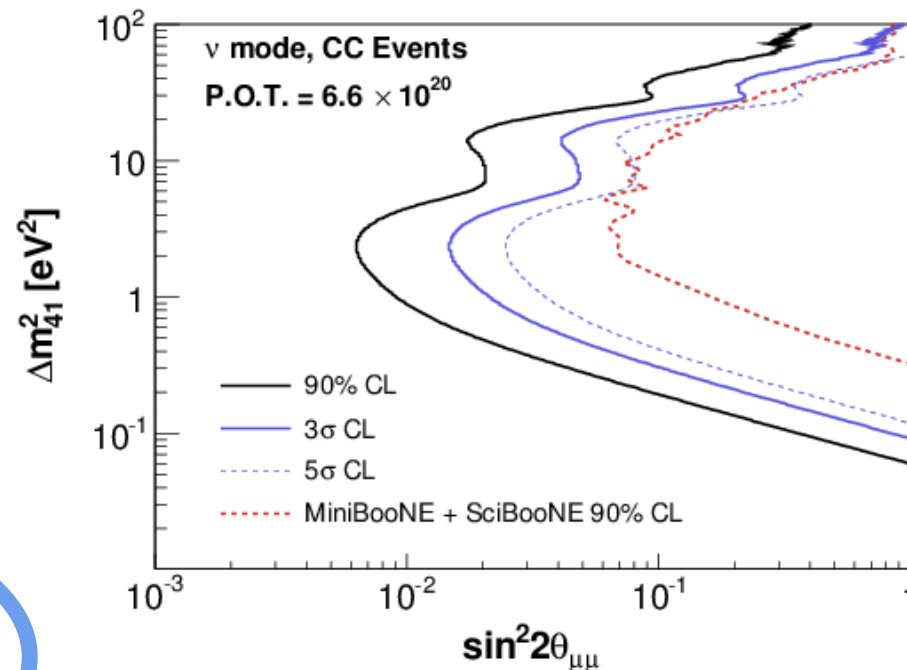
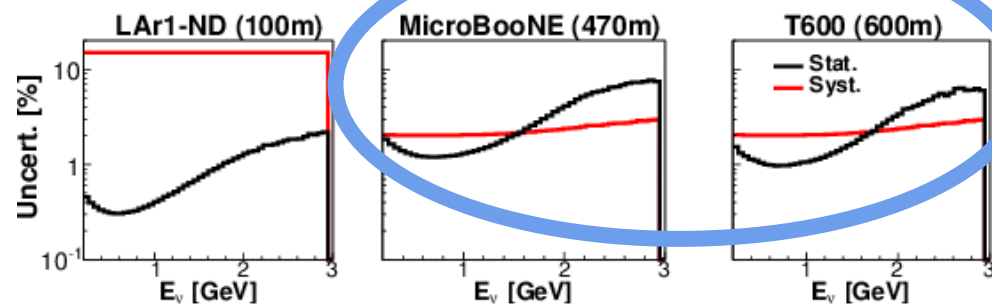
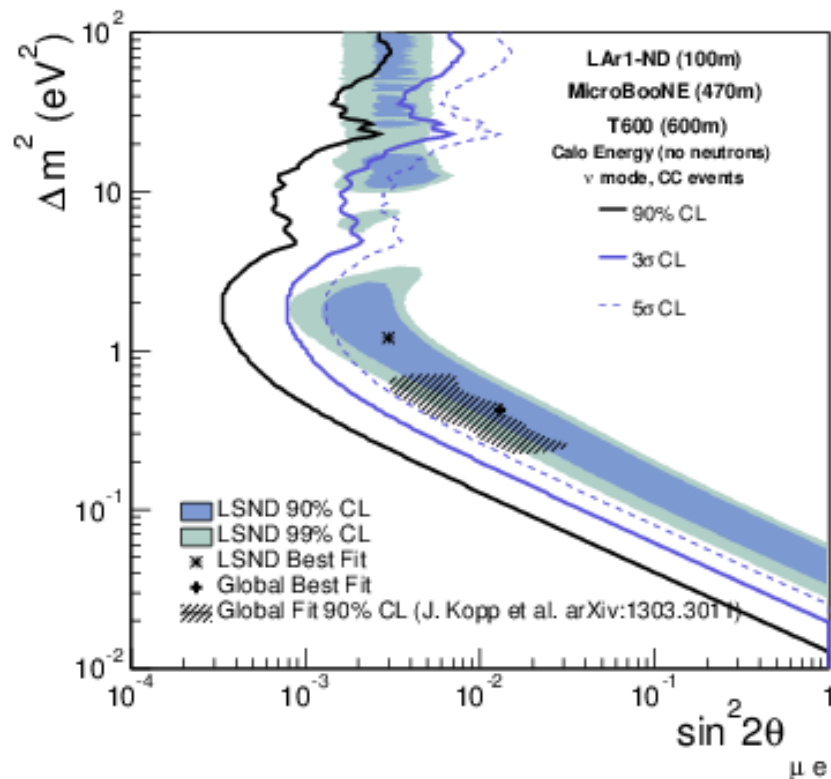
Flux Ratio Uncertainty (II)

In the mean time we can approximate this uncertainty

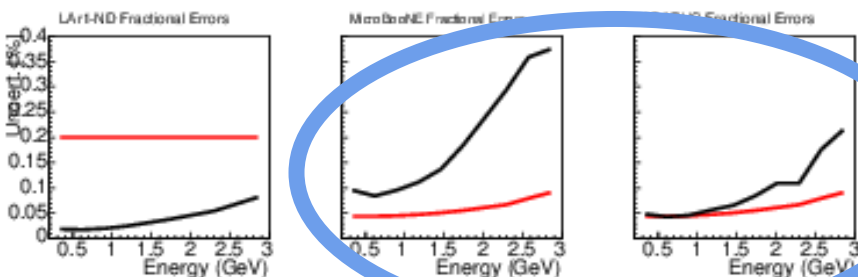
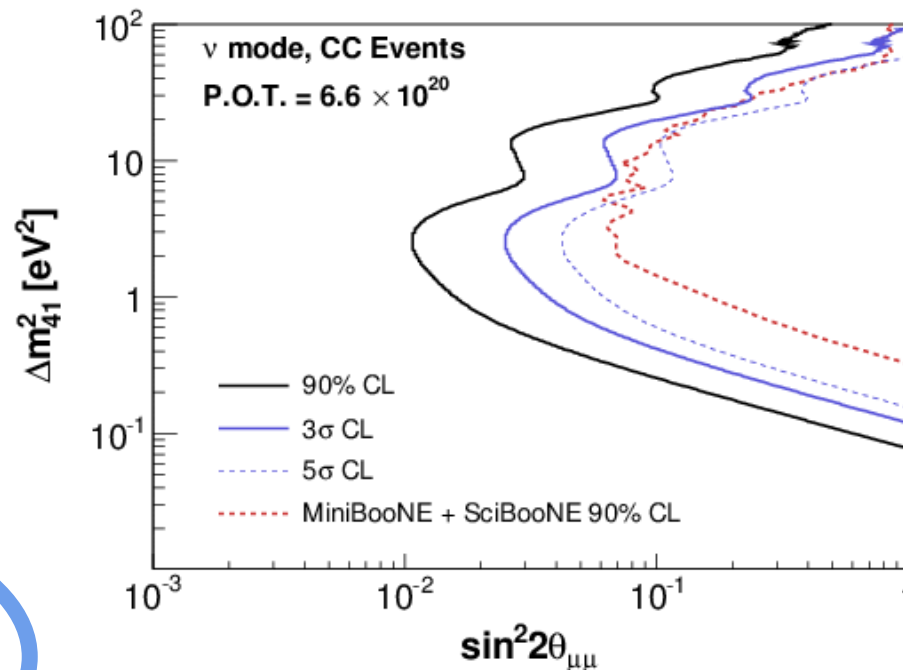
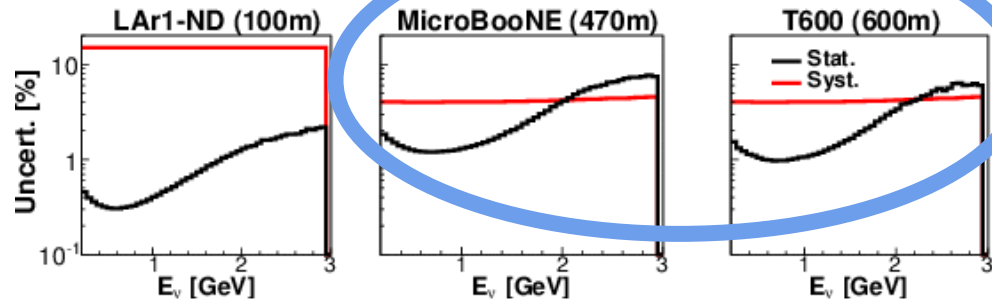
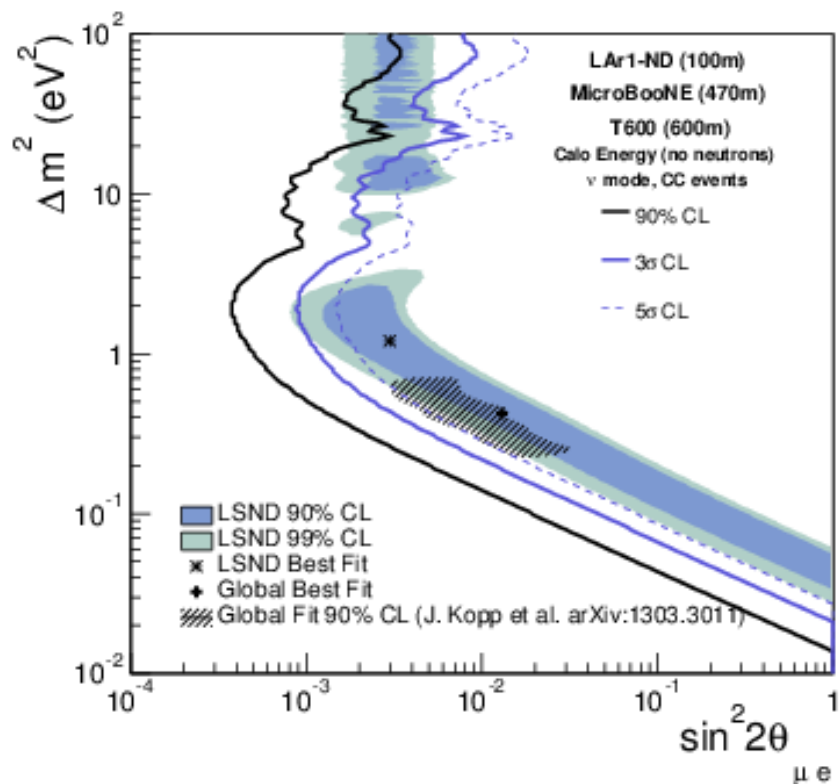
Studies (from the NESSiE collaboration) have shown that the systematics on the ratios are in the 2-3% range



Approximating a 2% Flux Uncertainty



Approximating a 4% Flux Uncertainty



Containment and Acceptance Syst.

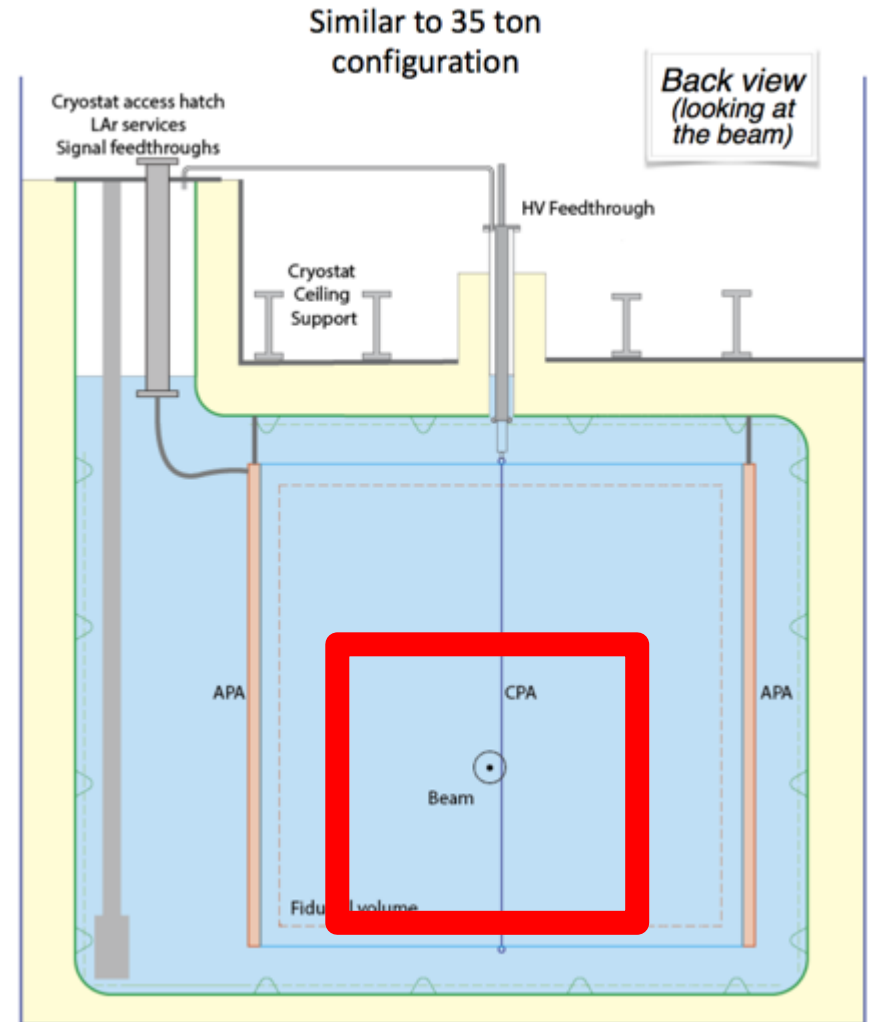
Another possible systematic that was discussed would come from differences in containment and acceptance in different detectors

To mitigate this effect we tried to modify the fiducial and active regions to be as similar as possible in both LAr1-ND and T600

This would have the effect of minimizing this systematic

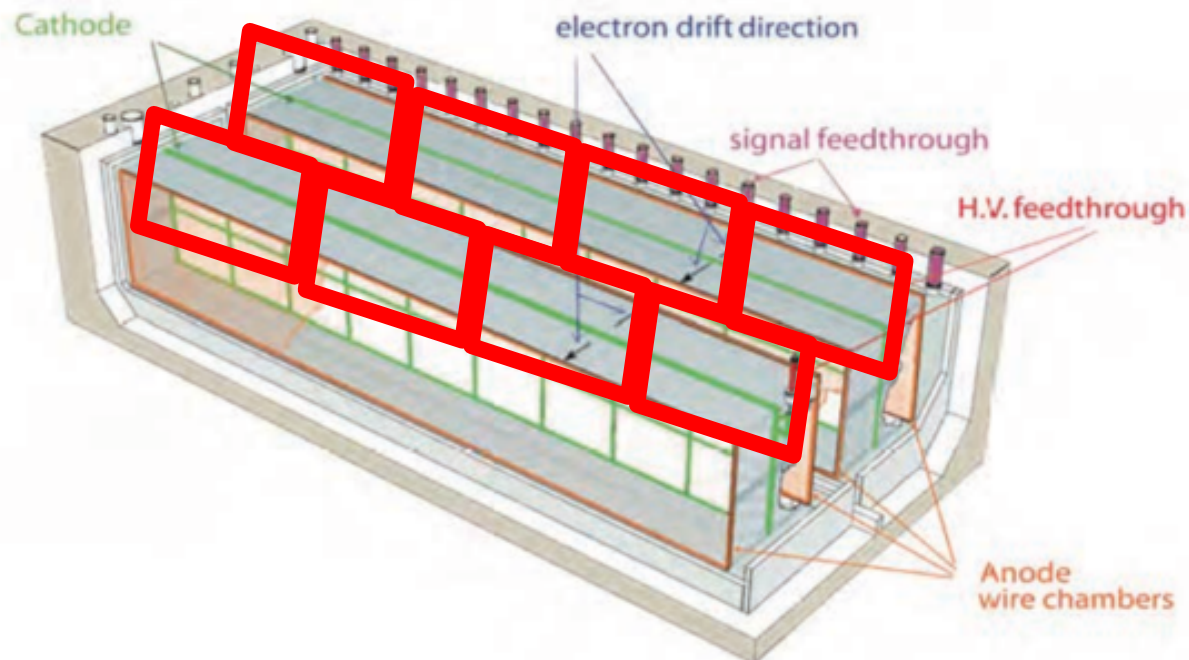
Modified Active and Fiducial Volume: LAr1-ND

Using the cross sectional area of one of the T300 modules we center a newly defined active and fiducial volume around the beam spot

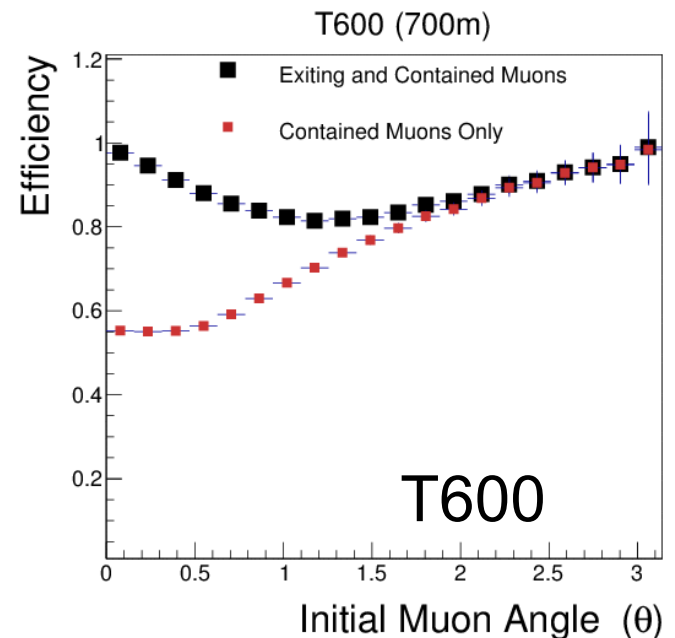
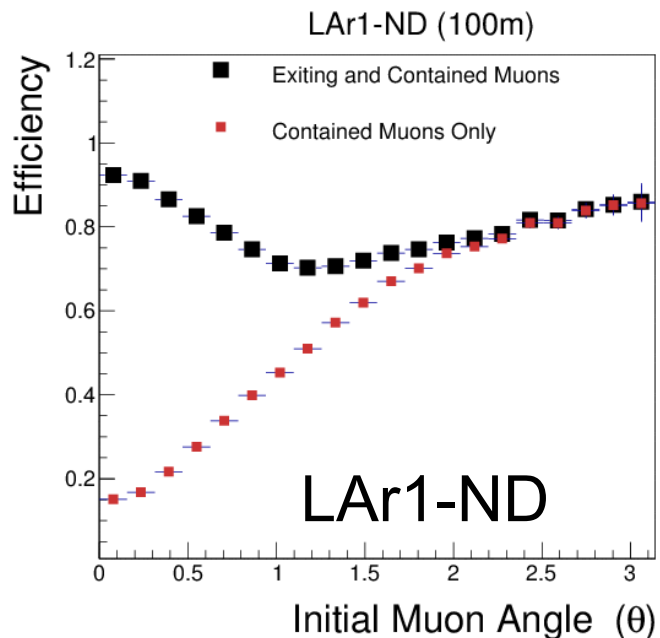
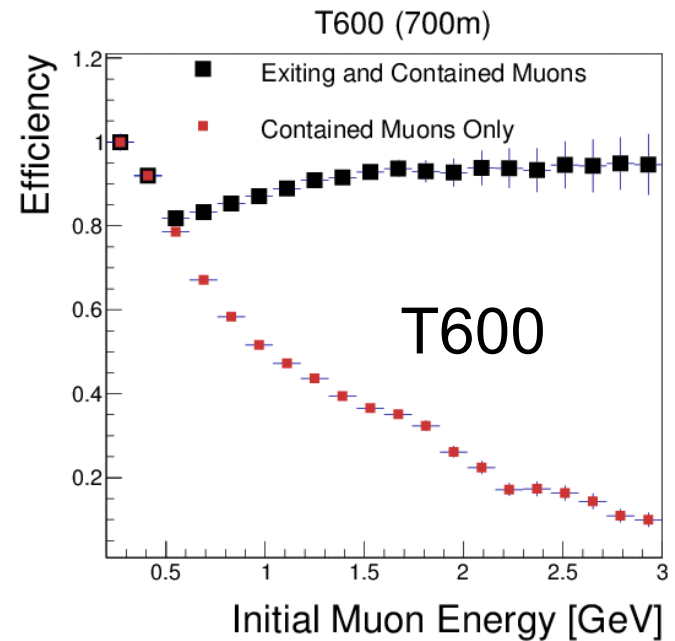
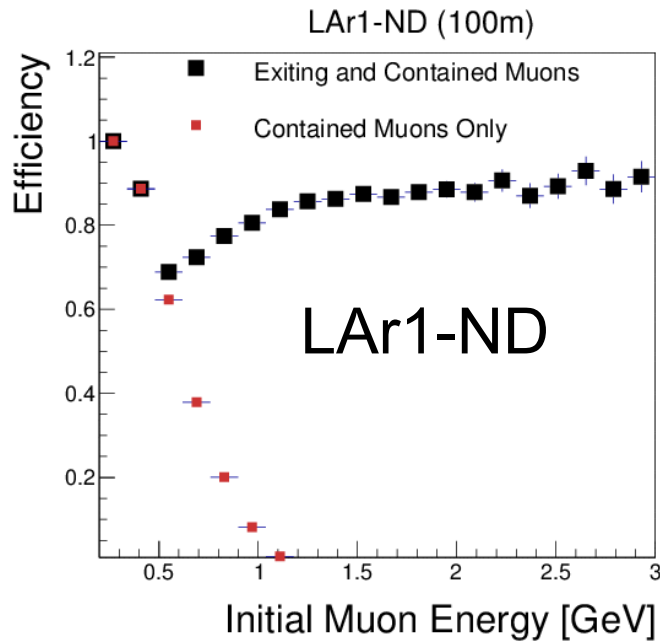


Modified Active and Fiducial Volume: T600

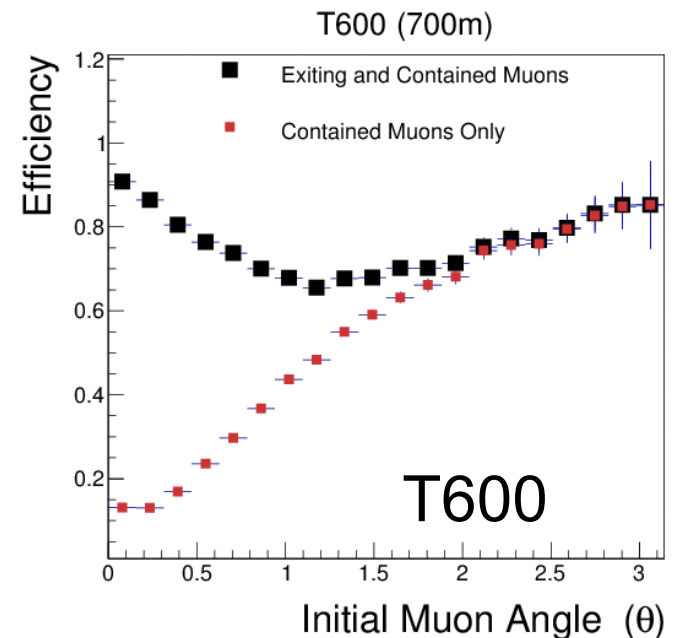
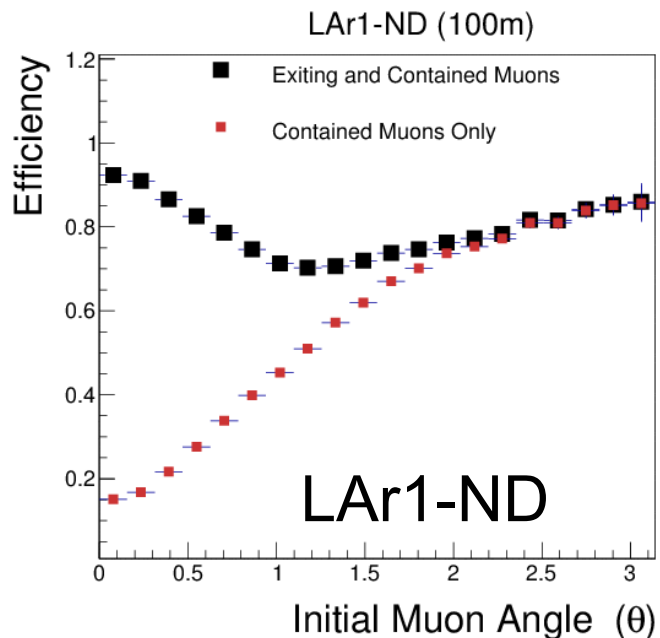
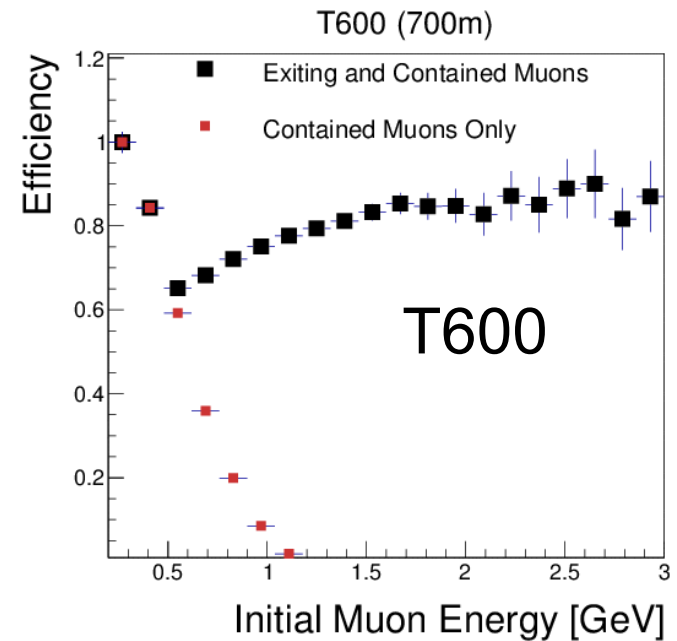
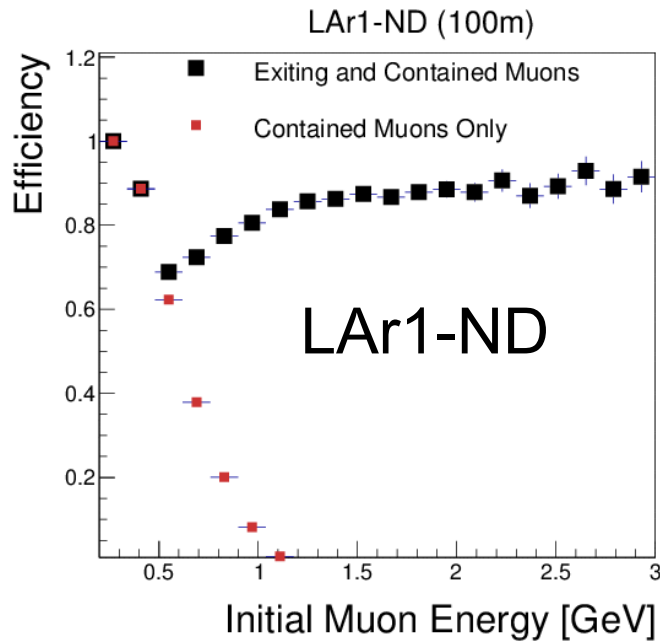
A similar exercise can be done with the T600, where it can be broken into roughly 8 LAr1-ND length sub-sections



Effect on Acceptances: Before



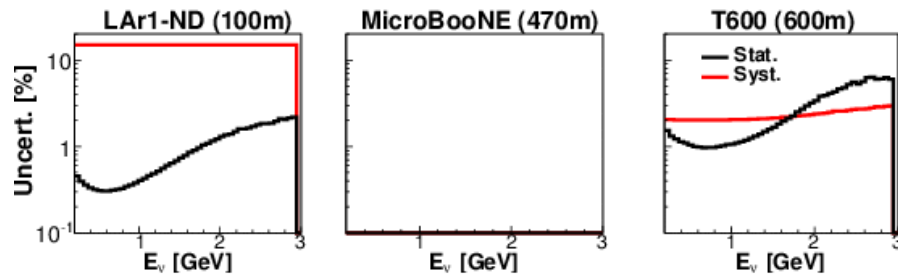
Effect on Acceptances: After



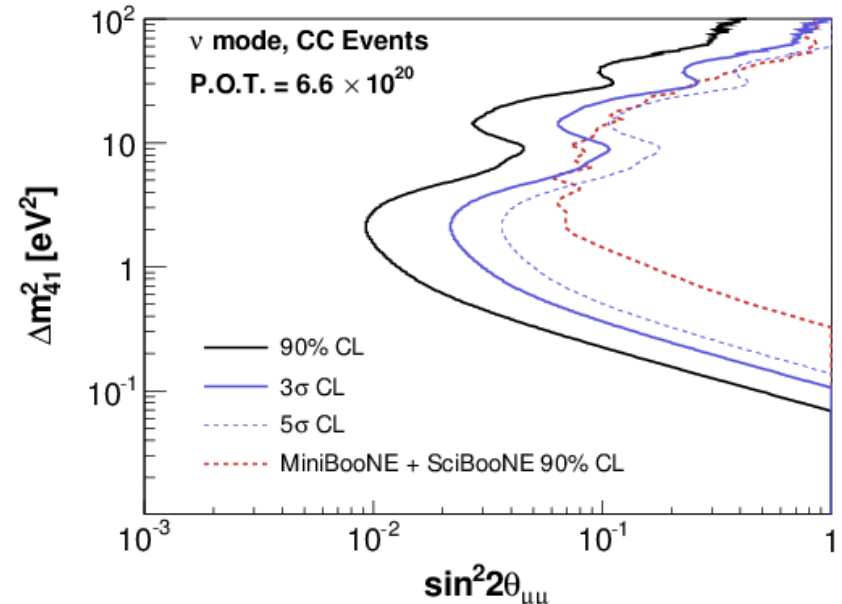
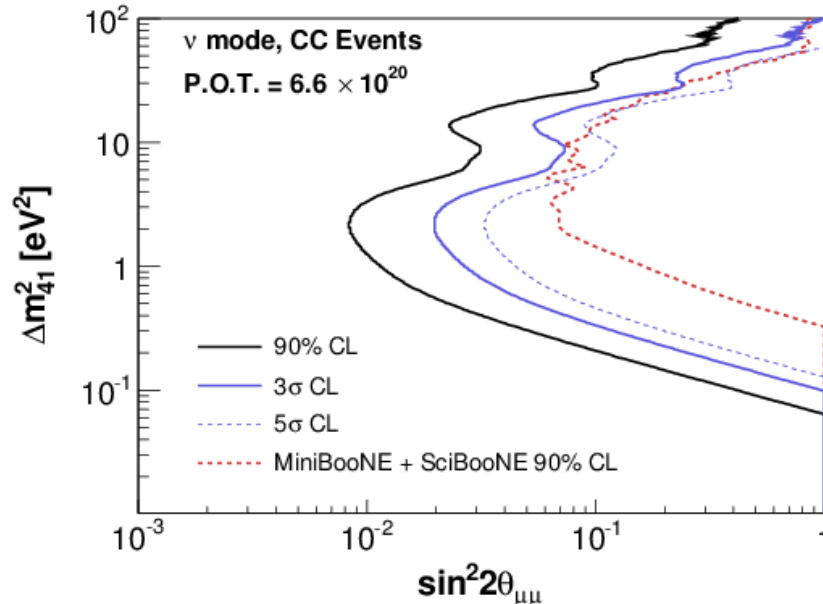
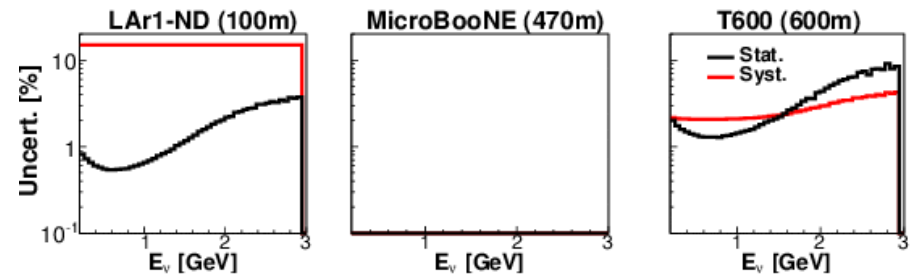
Matched Acceptances

The effect of this modification is to minimize this systematic but at the cost of reducing the statistics some in both detectors

Before

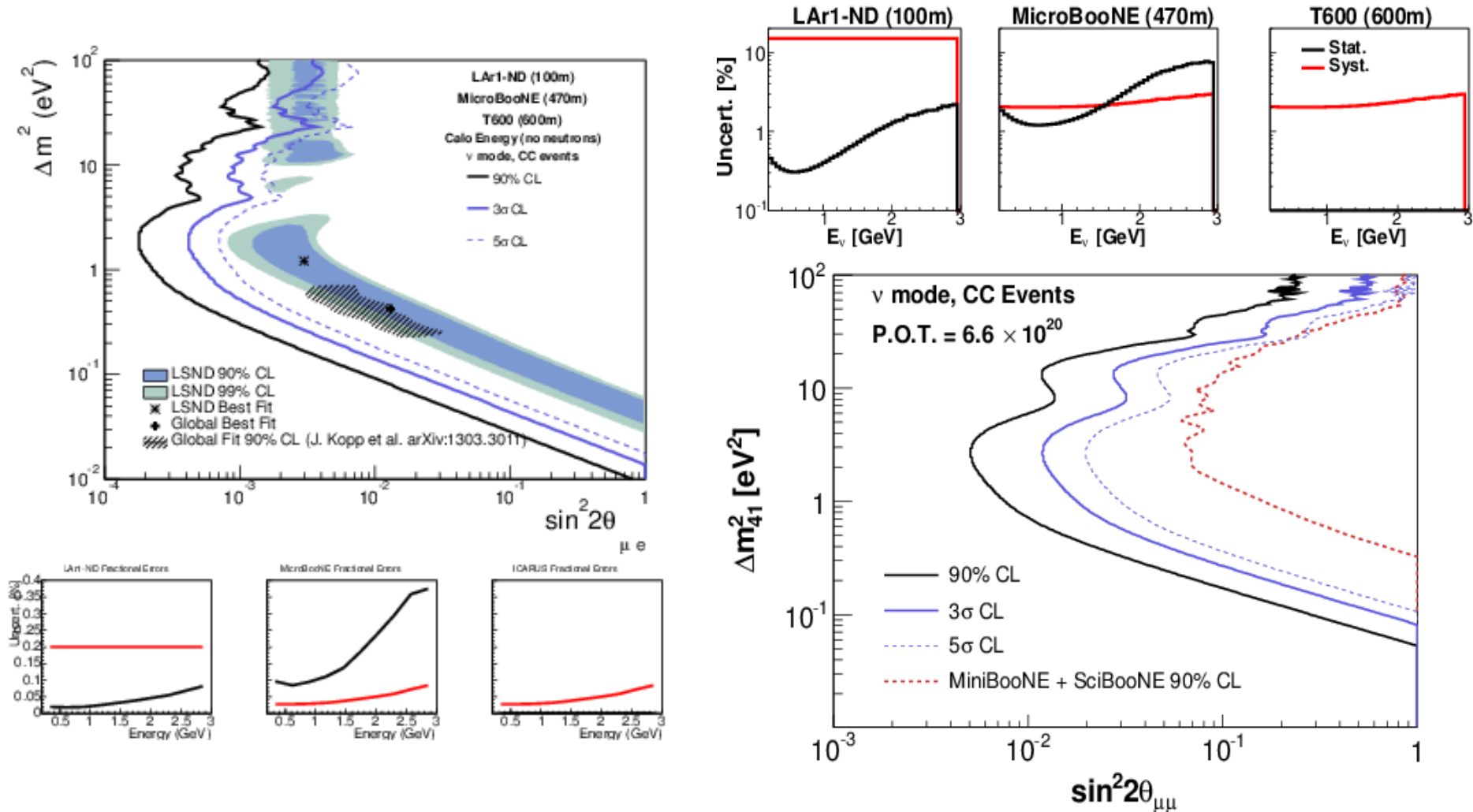


After



T600 with Infinite Statistics

Here the systematics are the ND stats + 2% flux ratio uncertainty propagated to the far detectors

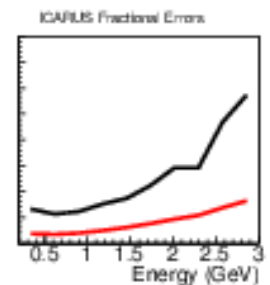
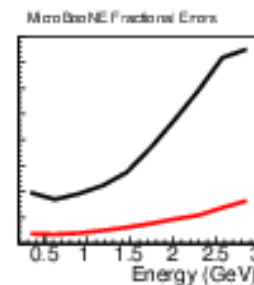
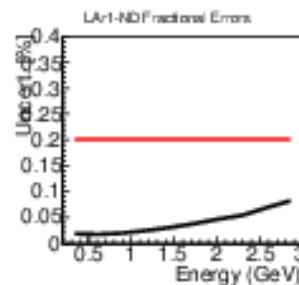
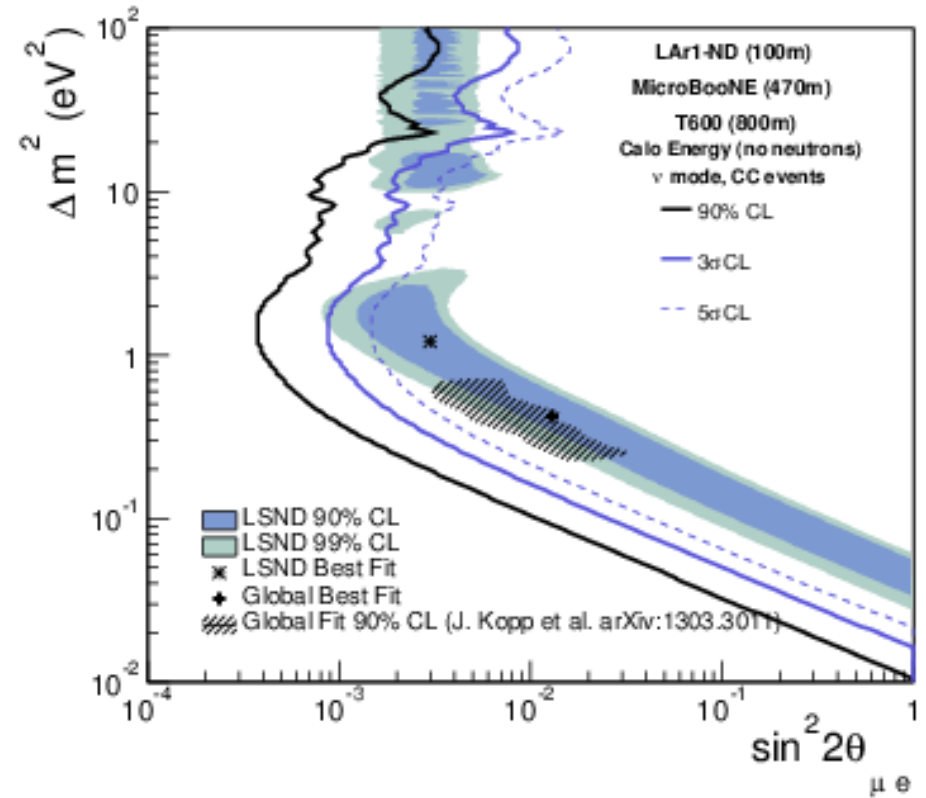


Additional Study: T600 @ 800m

Another choice would be to locate the T600 at **800m**

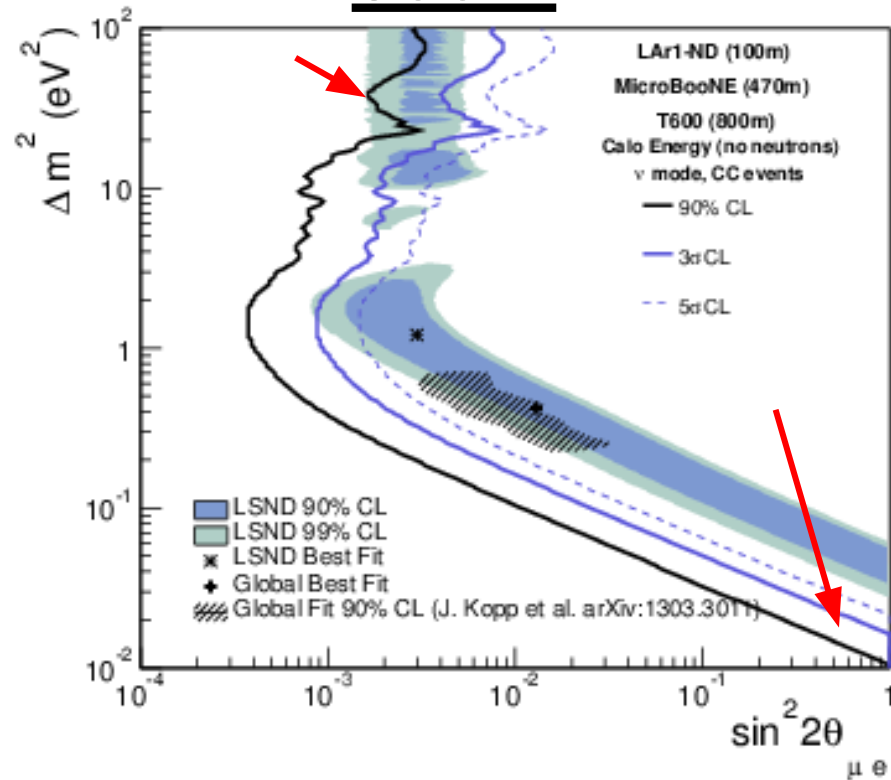
This has the downside of reducing the flux

We see a reduced sensitivity at high Δm^2 but an improved sensitivity at low Δm^2

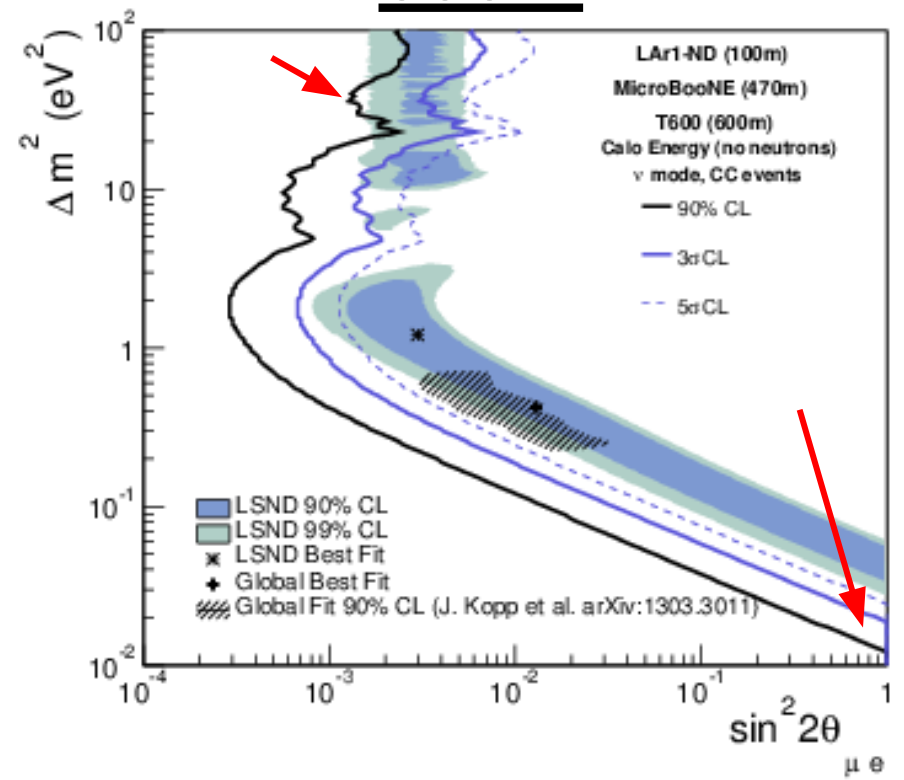


[NOTE: No Flux Uncert

800m



600m



[NOTE: No Flux Uncert Included]

To-do list

- 1) Flux ratio systematics**
- 2) Study the muon acceptance differences between the two detectors**
- 3) Effects of electron shower containment between the two detectors**
- 4) Analysis of cosmic ray backgrounds**
- 5) Analysis of dirt events coming from the beam**
- 6) Analysis of the reconfiguration of the Booster Beam (2nd horn? 25m absorber?)**

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We will be working closely with Zarko over the next couple of weeks to propagate the flux uncertainties from the MiniBooNE beam MC to our simulations and add these (with their correlations) to our sensitivity calculation